

NAUTILOID CEPHALOPODS FROM THE JULFA BEDS, UPPER PERMIAN, NORTHWEST IRAN

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ABSTRACT. Seventeen species of nautiloid cephalopods, from the Upper Permian Julfa Beds of northwestern Iran are described and discussed. They belong to twelve genera. Eight of the species are assigned to, or compared with, previously described species; the remainder is left unnamed. This appears to be one of the richest nautiloid faunas known from beds of very Late Permian age.

INTRODUCTION

Nautiloids of Late Permian age are extremely uncommon. In connection with our study of the Ali Bashi Formation³ at Kuh-e-Ali Bashi near Julfa, northwestern Iran (Teichert, Kummel, and Sweet, in press; Kummel and Teichert, 1971, and in press), we were able to collect a fairly large fauna of nautiloids from the underlying Julfa Beds. This report is a description and discussion of this fauna.

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PREVIOUS WORK

The first record of nautiloids from the Late Permian of the Transcaucasus was by

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³ This formation is being described by Teichert, Kummel, and Sweet (in press). It corresponds essentially to the "Transition beds" plus "Paratirolites beds" of Stepanov *et al.* (1969).

Abich (1878), who described the following species from the Araks (Araxes) Gorge west of Soviet Dzhulfa (the modern generic assignment is placed in parentheses):

Nautilus excentricus Eichwald
(*Permonautilus*)

Nautilus propinquus Abich
(*Liroceras*)

Nautilus parallelus Abich
(*Domatoceras*)

Nautilus convergens Abich
(*Stenopoceras*)

Nautilus concavus Sowerby
(*Liroceras*)

Nautilus dolerus Abich
(*Domatoceras*)

Nautilus dorsoarmatus Abich
(*Metacoceras*)

Nautilus pichleri v. Hauer
(*Pleuronautilus*)

Nautilus incertus Abich
(*Pleuronautilus*)

Nautilus tubercularis Abich
(*Pleuronautilus*)

Nautilus dorsoplicatus Abich
(*Tainoceras*)

Nautilus armeniacus Abich
(*Pseudotitanoceras*)

Nautilus cornutus Golovinski
(*Permonautilus*)

Orthoceras annulatum Sowerby
(?*Neocycloceras*)

Orthoceras cribrerosum Geinitz
(?)

Orthoceras transversum Abich
(?)
Orthoceras bicinctum Abich
(?)
Orthoceras margaritatum Abich
(?*Neocycloceras*)
Orthoceras turritellum Abich
(?)

Regardless of whether or not the species are narrowly defined, for a late Paleozoic fauna this an impressively diverse list. In a restudy of the Soviet Dzhulfian fauna Arthaber (*in* Frech and Arthaber, 1900) introduced only one new species, namely, *Pleuro-nautilus verae* Arthaber. Even the review of the stratigraphy and paleontology of these beds by Stoyanow (1910) resulted in only two new species of nautiloids—*Orthoceras lopingense* Stoyanow and *Nautilus hunicus* Diener. In fact these are the only nautiloids described by Stoyanow in that report.

In the comprehensive monograph on the Permo-Triassic formations of Soviet Dzhulfa, edited by V. E. Ruzhentsev and T. G. Sarycheva (1965), the nautiloids were studied by Shimanskiy, who recognized the following species from the *Araxoceras* and *Vedioceras* beds:

***Tainoceras dorsoplicatum* (Abich)
***Metacoceras dorsoarmatum* (Abich)
Metacoceras sp. 1 (ex. gr. *dorsoarmatum* Abich)
***Pseudotemnocheilus* sp.
***Foordiceras* sp. 1
***Foordiceras* cf. *grypoceroides* (Reed)
***Foordiceras* cf. *flemingianum* (Koninck)
***Tirolonutilus* sp.
**?*Hexagonites* sp.
***Pleuronautilus incertus* (Abich)
Pleuronautilus cf. *incertus* (Abich)
Pleuronautilus verae (Arthaber)
***Pleuronautilus tubercularis* (Abich)
**Pleuronautilus dzhulfensis* Shimanskiy
**Pleuronautilus costalis* Shimanskiy
Pleuronautilus sp.
**?*Phaedrysmocheilus* sp.
***Domatoceras convergens* (Abich)

**Domatoceras atypicum* Shimanskiy
***Domatoceras hunicum* (Diener)
**Domatoceras gracile* Shimanskiy
***Domatoceras parallelum* (Abich)
Domatoceras cf. *gracile* Shimanskiy
***Domatoceras* sp. 1
**Pseudotitanoceras armeniacum* (Abich)
Permonautilus abichi (Kruglov)
Permonautilus sp.
**?*Stearoceras* sp.
***Paranautilus peregrinus* (Waagen)
**Styrionautilus* sp.
***Neocycloceras obliqueannulatum* (Waagen)
**?*Neocycloceras* cf. *cyclophorum* (Waagen)
**?*Neocycloceras margaritatum* (Abich)
?*Neocycloceras* cf. *margaritatum* (Abich)
***Lopingoceras lopingense* (Stoyanow)
Lopingoceras cf. *lopingense* (Stoyanow)
***Cycloceras bicinctum* (Abich)

Only six of these species were completely described and illustrated in the text. These are indicated by a single asterisk in the above list. A number of species were illustrated on plates but were not described in the text, and these are indicated in the above list by a double asterisk. A few general comments on this impressive list of species are in order. *Pseudotemnocheilus* we regard as a synonym of *Temnocheilus*. The illustration by Shimanskiy (*in* Ruzhentsev and Sarycheva, 1965, pl. 14, fig. 7) of a specimen of *Pseudotemnocheilus* is very poor, but it seems to be possibly conspecific with what we describe here as *Temnocheilus* sp. indet. The illustrations of the various species of *Foordiceras* appear to be similar to specimens we assign to *Pleuronautilus* sp. indet. 2. *Tirolonutilus* sp. and *Hexagonites* sp. were both based on single, very fragmentary specimens. On the basis of the illustrations of these specimens, we do not believe that they are generically identifiable. The generic identification of *Phaedrysmocheilus* and *Stearoceras* were

questioned by Shimanskiy, and, on the basis of the illustrations he presented, we agree that these identifications are doubtful. Excluding the orthocerids it appears that this nautiloid fauna of Soviet Dzhulfa includes nine genera, which, as late Paleozoic nautiloid faunas go, is a large number.

PRESENT INVESTIGATIONS

The specimens described in the present paper were collected by us from that part of the section which Stepanov *et al.* (1969) called Julfa Beds. These correspond to the Dzhulfian Stage (Dzhulfinskiy Yarus) of Arakelyan, Grunt, and Shevyrev (*in Ruzhentsev and Sarycheva, 1965: 23*). All collections were obtained in a small side valley, parallel to the main access valley to Kuh-e-Ali Bashi, about 8 km west of Julfa and about 200–300 m upstream from our Ali Bashi locality 4 (Teichert, Kummel, and Sweet, *in press*). Our collections contain the following genera and species:

- Lopingoceras lopingense* (Stoyanow)
- Lopingoceras* sp. cf. *L. lopingense* (Stoyanow)
- Neocycloceras* sp. cf. *N. obliqueannulatum* (Waagen)
- Tainoceras* sp. indet.
- Metacoceras dorashamense* Shimanskiy
- Metacoceras dorsoarmatum* (Abich)
- Pleuromutilus* sp. indet. 1
- Pleuromutilus* sp. indet. 2
- Tainionutilus* sp. indet.
- Temnocheilus* sp. indet.
- Domatoceras humicum* (Diener)
- Domatoceras parallelum* (Abich)
- Domatoceras* sp. indet.
- Stenopoceras* sp. indet.
- Titanoceras* sp. indet.
- Pseudotitanoceras armeniacum* (Abich)
- Liroceras* sp. indet.

This fauna is essentially the same as that from the corresponding beds at Soviet Dzhulfa except for the presence of *Temnocheilus*, *Tainionutilus*, and *Titanoceras*. At the same time the Kuh-e-Ali Bashi fauna

does not include *Permonutilus*, *Paranutilus*, and *Styrionutilus*.

In an analysis of the nautiloid fauna of the Julfa Beds it is important to consider the fauna of the overlying Ali Bashi Formation. It is these strata that are of prime importance in consideration of the Permian-Triassic boundary of this region. Shimanskiy (*in Ruzhentsev and Sarycheva, 1965: 41*) listed the following species from the equivalents of the Ali Bashi Formation at Soviet Dzhulfa (*Phisonites* beds plus beds 1–4 of the "Induan stage"):

- Tainoceras* sp. 1 (ex. gr. *changlingpuense* Chao)
- Tainoceras* sp. 2 (ex. gr. *changlingpuense* Chao)
- Tainoceras* sp. 3
- Metacoceras* sp. 2 (ex. gr. *dorsoarmatum* Abich)
- ?*Foordiceras* sp. 2
- Pleuromutilus* sp. (ex. gr. *dieneri* v. Krafft)
- ?*Pleuromutilus* sp.
- Tainionutilus* sp.
- Domatoceras* sp. 2
- ?*Syringonutilus vagus* Shimanskiy
- ?*Paranutilus* sp.
- ?*Neocycloceras* sp.

Only ?*Syringonutilus vagus* Shimanskiy was described and illustrated (*in Ruzhentsev and Sarycheva, 1965: 163, pl. 16, fig. 9*). Most of the remaining species were illustrated by photographs, unaccompanied by descriptions. The specimen assigned to ?*Syringonutilus*, to judge from the illustration, appears to be more likely to represent a species of *Stearoceras*.

Teichert, Kummel, and Sweet (*in press*) describe the following species of nautiloids from the Ali Bashi Formation at Kuh-e-Ali Bashi:

- ?*Dolorthoceras* sp.
- Neocycloceras* sp.
- Lopingoceras* sp.
- Tainoceras* sp. indet.
- Metacoceras* sp. indet.

TABLE I
DISTRIBUTION OF NAUTILOID GENERA IN JULFA
BEDS AND ALI BASHI FORMATION

	Julfa Beds	Ali Bashi Form.
? <i>Dolorthoceras</i>		×
<i>Neocycloceras</i>	×	×
<i>Lopingoceras</i>	×	×
<i>Tainoceras</i>	×	×
<i>Metacoceras</i>	×	×
<i>Pleuromutilus</i>	×	×
<i>Tainionutilus</i>	×	×
<i>Temnocheilus</i>	×	×
<i>Domatoceras</i>	×	×
<i>Pseudotitanoceras</i>	×	
? <i>Stearoceras</i>	×	×
<i>Stenopoceras</i>	×	×
<i>Titanoceras</i>	×	
<i>Styrionutilus</i>	×	
<i>Liroceras</i>	×	×
<i>Paranutilus</i>	×	×
<i>Permonutilus</i>	×	

Pleuromutilus sp. indet.

Temnocheilus sp. indet.

Domatoceras sp. indet.

Liroceras sp. indet.

Paranutilus sp. indet.

It can readily be seen that this fauna is essentially the same as that described by Shimanskiy from Soviet Dzhulfa and that these faunas contain elements of those of the underlying Julfa Beds. The stratigraphic distribution of the nautiloids now known from the Julfa Beds and the Ali Bashi Formation at Kuh-e-Ali Bashi and Soviet Dzhulfa is shown in Table 1.

In the controversy as to whether the Ali Bashi Formation is Permian or Triassic in age, nautiloids are not helpful. A comprehensive review of the relationship of Permian and Triassic nautiloids has been presented by Kummel (1953) and restated by the same author in the *Treatise on Invertebrate Paleontology*, Part K (Teichert *et al.*, 1964). The situation has been summarized as follows: "Evolution of the nautiloids in the Triassic is mostly one of culminating patterns and modes started in the late Paleozoic" (Kummel, 1953: 1). The relationships of

late Paleozoic and Triassic nautiloid genera are shown in Figure 1. The nautiloid fauna of the Julfa Beds includes most of the genera that are present in Late Permian and Early Triassic rocks. This further emphasizes the continuity of evolution of the nautiloids across the Permian-Triassic boundary, in contrast to the history of extinction and radiation displayed by the ammonoids at this boundary.

SYSTEMATIC PALEONTOLOGY

Class **CEPHALOPODA** Cuvier, 1798

Order **ORTHO CERIDA** Kuhn, 1940

Family and superfamily uncertain

About 30 fragments of shells of orthoconic nautiloids in our collections are assigned by us to the genera *Neocycloceras* Flower and Caster and *Lopingoceras* Shimanskiy. Both genera have been placed in the Pseudorthoceratidae with more or less confidence by Shimanskiy and by Sweet (see references below). Since the siphuncle structures of the type species of both genera are not well known, we conclude that *Neocycloceras* and *Lopingoceras* are of uncertain family affinities.

Genus *Lopingoceras* Shimanskiy,
in Ruzhentsev, 1962

Type species, *Orthoceras lopingense*
Stoyanow, 1910

This genus was described by Shimanskiy (*in Ruzhentsev, 1962: 90*) as follows (transl. from Russian): "Conch with transverse rings [which are] angular in section. Sutures situated in the intervals between rings, parallel to them and perpendicular or slightly inclined to the longitudinal axis of the conch. Siphuncle segments longitudinally ellipsoidal." The type species was described by Stoyanow (1910: 70) from the Upper Permian of Dzhulfa, and Shimanskiy (*in Ruzhentsev, 1962*) mentioned occurrences of the genus in Yugoslavia, Tirol, and China, but gave no references to published descriptions. Barskov (1963)



Figure 1. Diagram showing inferred phylogeny and geologic distribution of late Paleozoic and Triassic coiled nautiloids. (Adapted from Kummel, 1953.)

placed *Lopingoceras* in his newly established family, Pseudocycloceratidae, without stating reasons.

Lopingoceras lopingense (Stoyanow)
Plate 4, figures 9, 11

Orthoceras lopingense Stoyanow, 1910: 70, pl. 7, figs. 2, 3.

Lopingoceras lopingense (Stoyanow), – Shimanskiy, in Ruzhentsev and Sarycheva, 1965: 41, 42, pl. 16, fig. 10.

Description. Our collections contain at least four fragmentary specimens that we assign to *Lopingoceras lopingense*. When he established this species, Stoyanow (1910: 70) cited angularity of outline of the annulations as its most important distinguishing feature, but did not really give a formal description of it. Since the species is known only from fragmentary phragmocones and living chambers, a complete description is difficult to give.

Obviously, the conch is longiconic and straight. The sutures are straight and the chambers quite short, each chamber bearing one annulation that thus runs parallel to the sutures. The specimen figured on Plate 4, figure 11, is a fragmentary phragmocone consisting of three entire and two fragmentary chambers. Of the three entire chambers two are short and one is long. Their lengths are 2.8, 3.0, and 5.6 mm. Thus, the third chamber is about twice as long as each of the first two and it carries two rings, instead of one. Apparently, we are here concerned with one of the rare cases where construction of a septum was skipped. Teichert (in Teichert *et al.*, 1964: K31, K52) has cited from the literature some previously described cases of this kind.

Remarks. Stoyanow (1910: 103) listed *Orthoceras lopingense* from a bed he called "Cephalopoda-zone," 11 to 14 m above the base of his Dzhulfa section. Shimanskiy (in Ruzhentsev and Sarycheva, 1965: 42) listed the species only from the *Araxoceras* Zone, the lowest of the Dzhulfian zones.

Repository. MCZ 9774 (Pl. 4, fig. 9),

MCZ 9776 (Pl. 4, fig. 11), unfigured specimens KU 34435.

Lopingoceras sp. cf. *L. lopingense*
(Stoyanow)

Plate 4, figures 13, 14

Description. Our collections contain at least four fragments of phragmocones that are similar to those here placed in *Lopingoceras lopingense*, except that the number of annulations per chamber is normally two. In addition the conch tends to be compressed in cross section rather than circular. On the more narrowly rounded sides the annulations form narrow lobes, while the sutures remain straight (Pl. 4, fig. 14). The length of the chambers is 2.8 to 3.0 mm, or about the same as the length of normal chambers of *L. lopingense*. In one piece, which consists of five camerae, or parts thereof, and of the basal part of the living chamber, the length of four of the chambers is 2.8 mm, but that of the last camera is 2.0 mm, and it bears only one ring.

Remarks. A character which these specimens share with typical *Lopingoceras lopingense* is the angularity in perpendicular section of the annulations. No similar forms are as yet known from the Dzhulfian beds near Soviet Dzhulfa.

Repository. MCZ 9775 (Pl. 4, figs. 13, 14), unfigured specimen KU 34431.

Genus *Neocycloceras* Flower & Caster 1935

Type species, *Neocycloceras obliquum*
Flower and Caster, 1935

Flower and Caster (1935: 15) stated that this genus was separated from "other annulated forms by the oblique sinuous sutures and the eccentric nummuloidal siphuncle." It is further characterized by "large, sinuous and slightly oblique annulations." Flower and Caster placed the genus questionably in the family Orthoceratidae Hyatt. Flower (1939: 309) placed it equally questionably in the Pseudorthoceratidae, and maintained this position in subsequent publications (Flower, 1941:

475; 1943: 107; 1945: 685), whereas Flower and Kummel (1950: 610) included the genus without query in that family. Both Shimanskiy (*in* Ruzhentsev and Sarycheva, 1965) and Sweet (*in* Teichert *et al.*, 1964) placed *Neocycloceras* in the family Pseudorthoceratidae. Sweet, however, with reservations.

The range of the genus is stated to be Upper Devonian to Lower Carboniferous by Sweet (*in* Teichert *et al.*, 1964), and Devonian to Lower Carboniferous and Upper Permian by Shimanskiy (*in* Ruzhentsev, 1962).

Neocycloceras sp. cf. *N. obliqueannulatum*
(Waagen)

Plate 4, figures 10, 12

cf. *Orthoceras obliqueannulatum* Waagen, 1879: 69, 70, pl. 6, figs. 9, 10.

Description. A number of fragmentary conch parts, ranging from about 4 mm to about 20 mm in conch diameter, are almost certainly assignable to the genus *Neocycloceras* and may be related to the species described by Waagen as *Orthoceras obliqueannulatum*. All our specimens are more or less fragmentary living chambers and two of them have parts of camerae attached to their bottom.

The largest specimen (Pl. 4, fig. 12) is a living chamber that is probably complete, with one camera attached at the bottom. The camera is 6.5 mm long and about 18 mm wide and it seems to bear one annulation. However, only one-half of the outside of the camera is preserved. The living chamber is 24 mm long. The aperture has an elliptical outline, having diameters of 19 and 14 mm respectively. The living chamber bears five annulations, the last one situated close to the apertural margin. The annulations are strong, rising at least 1 mm above the depressions between them, and these are wider than the annulations. The annulations cross one of the broad sides of the shell in a low arch, slope adapically across the two narrow sides, and

cross the opposite broad side of the shell almost horizontally. Only one-half of the last suture of the phragmocone is preserved; it slopes in the same direction as the annulations.

We have three additional fragments of living chambers of comparable size, but of poorer preservation. As far as one can judge, their features are essentially the same as those of the living chamber described above.

In addition, our collections contain five fragments of considerably smaller living chambers with oblique annulations, the largest of these having long and short shell diameters of 10.5 and 9.5 mm respectively. Two of these have fragments of camerae attached to them which allow one to observe that the sutures are oblique. In all specimens the cross section of the shell is more or less elliptical. Whether or not these smaller specimens belong to the same species as the larger ones described above could presumably be decided on the basis of a larger sample.

The siphuncle cannot be observed in any of the specimens.

Remarks. The reason for our uncertainty in the proper taxonomic assignment of the Julfa specimens lies in the deficiencies of Waagen's description of the type material, which came from the Chhidru Formation ("upper Productus limestone") of the Salt Range of West Pakistan. Waagen (1879: 69) himself admitted that his few fragments "seem barely sufficient for the foundation of a species," although the oblique annulations seemed to him such a characteristic feature that he did in fact establish the species. Unfortunately, he seemed to be unable to observe the sutures, for he does not mention them.

Miller and Unklesbay (1942) referred Waagen's species questionably to the genus *Brachycycloceras*. However, the annulations in that genus are not oblique.

The species has been recorded and in part illustrated from the Dzhulfian beds near Dzhulfa (Arthaber, *in* Frech and

Arthaber, 1900: 210; Shimanskiy, in Ruzhentsev and Sarycheva, 1965: 41), from Loping in Kiangsi, China (Frech, 1911: 108), and from the Aghil Mountains in Tibet (Renz, 1940: 67).

Repository. KU 34411 (Pl. 4, fig. 10), MCZ 9777 (Pl. 4, fig. 12), unfigured specimens MCZ 9778, KU 34412.

Order **NAUTILIDA** Agassiz, 1847

Superfamily **TAINOCERATA**CEAE

Hyatt, 1883

Family **TAINOCERATIDAE** Hyatt, 1883

Genus *Tainoceras* Hyatt, 1883

Type species, *Nautilus quadrangulus*

McChesney, 1860

Tainoceras sp. indet.

Plate 4, figures 1, 2

Discussion. This record is based on a fairly well-preserved phragmocone 74 mm in diameter. The width of the most adoral camera is 51.5 mm and the height 36 mm. The conch is moderately involute with an oval whorl section. The venter is broadly rounded with a prominent median furrow. The ventrolateral shoulders are broadly rounded, merging imperceptibly into convex lateral areas. The umbilical shoulders are more abruptly rounded and the umbilical wall steep; the umbilicus has a diameter of approximately 22 mm. The ornament consists of a row of nodes on the venter adjoining each side of the ventral furrow and another row of nodes on the ventrolateral shoulder. The nodes are generally located on the adoral part of each camera. The suture consists of a deep ventral lobe in the ventral furrow and a shallow lateral lobe on the flanks.

Shimanskiy (in Ruzhentsev and Sarycheva, 1965: 41) lists *Tainoceras dorsoplicatum* (Abich) from the *Araxoceras* beds of Soviet Dzhulfa. His table indicates that he had three specimens, but no formal description was given and only one specimen, a small fragment of phragmocone, was illustrated. Specific identification of

this fragment does not seem justified. The illustrations and descriptions of *Nautilus dorsoplicatus* Abich (1878: 23, pl. 2, fig. 6; pl. 3, fig. 1; pl. 4, fig. 8) are most unsatisfactory. The specimen illustrated by Abich on his plate 4, figure 8 does show marked similarities to that in our collection. Even so it seems unwise to assign a specific name to our specimen. Shimanskiy also listed four specimens assigned to three indeterminate species of *Tainoceras* from the Ali Bashi Formation of Soviet Dzhulfa. Two of these forms were illustrated but not described. The illustrations clearly show the specimens to be species of *Tainoceras*, but the incompleteness of the specimens and their poor preservation make specific identification impossible. Our collections from the Ali Bashi Formation at Kuh-e-Ali Bashi contain one fragmentary specimen of *Tainoceras*.

In a review of the genus *Tainoceras*, Kummel (1953: 24) recorded 23 species assignable to the genus. It has a range from Middle Pennsylvanian to Late Permian in age and one species, *Trematodiscus klipsteini* Mojsisovics (1882) from the Karnian of the Alps, is also included in this genus.

Repository. MCZ 9752 (Pl. 4, figs. 1, 2).

Genus **Metacoceras** Hyatt, 1883

Type species, *Nautilus (Discus) sangamonensis* Meek and Worthen, 1861

Metacoceras dorashamense Shimanskiy

Plate 4, figures 5, 6

Metacoceras dorashamense Shimanskiy, in Ruzhentsev and Sarycheva, 1965: 157, pl. 14, fig. 3.

Discussion. Our collections contain nine specimens mainly of poor preservation. The only complete specimen (Pl. 4, figs. 5, 6) is a phragmocone measuring 39 mm in diameter, 23 mm for the width of the adoral whorl, and 17 mm for the height. Shimanskiy distinguished his species primarily on the presence of nodes on both the ventrolateral and umbilical shoulders, the latter being very small, and on ribs between the

nodes increasing in prominence toward the ventrolateral node. The umbilical nodes are not apparent on the one illustration Shimanskiy (in Ruzhentsev and Sarycheva, 1965, pl. 14, fig. 3b) published. The ventrolateral nodes are very conspicuous and the so-called ribs are lateral extensions from these nodes. This is the general nature of the ornament pattern in our specimens.

In a general review of the genus *Metacoceras*, Kummel (1953) noted that: "The high degree of variation and few or poorly preserved specimens prevent a thorough understanding of most of the species. There are more than twice as many species of *Metacoceras* (50) as of any other Pennsylvanian and Permian nautiloid." Shimanskiy had only two specimens of his new species and the illustrated type is surely the phragmocone of a juvenile. Our specimens are of limited help in broadening the understanding of this species because of their fragmentary nature and generally poor preservation. As there are no data on the range of variation in ornament for any species of *Metacoceras*, direct comparison of species is meaningless. The only significance of the large number of species assigned to this genus is an indication of the widespread distribution and general abundance of *Metacoceras* in marine seaways of Pennsylvanian and Permian age.

In addition to *Metacoceras dorashamense*, Shimanskiy's fauna also includes *Metacoceras dorsoarmatum* (Abich). The latter species was said to differ in having only ventrolateral nodes. Our collections also contain specimens assignable to *M. dorsoarmatum*, but the really significant difference from *M. dorashamense* is in the more or less quadrate whorl section. Our collections from the overlying Ali Bashi Formation contain one fragment of a phragmocone, which, on the basis of its depressed whorl section, appears to be a representative of *M. dorashamense*. In Soviet Dzhulfia Shimanskiy listed from the beds with *Phisonites* one specimen attributed to *Metacoceras* sp. 2 (ex. gr. *dorsoarmatum* Abich).

Repository. MCZ 9753 (Pl. 4, figs. 5, 6), unfigured specimens MCZ 9754.

Metacoceras dorsoarmatum (Abich)

Plate 3, figures 5, 6

Nautilus dorsoarmatus Abich, 1878: 20, pl. 4, figs. 1, 1a.

Metacoceras dorsoarmatum, – Shimanskiy, in Ruzhentsev and Sarycheva, 1965: 41, pl. 14, fig. 5.

Discussion. This species differs from *Metacoceras dorashamense* in having a more subquadrate whorl section rather than a depressed whorl section. Likewise there are no nodes on the umbilical shoulder. The prominent ventrolateral nodes taper off up the lateral areas, giving the appearance of incipient ribs. The largest specimen in our collection (Pl. 3, figs. 5, 6) is a phragmocone 37.5 mm in diameter; the most adoral whorl has a width of 17.7 mm and a height of 16 mm. The remaining six specimens are fragments of phragmocone. General comments on the genus *Metacoceras* and the species from the Julfa Beds are offered in the preceding section.

Repository. MCZ 9755 (Pl. 3, figs. 5, 6), unfigured specimens MCZ 9756.

Genus *Pleuromutilus* Mojsisovics, 1882

Type species, *Pleuromutilus trinodosus*
Mojsisovics, 1882

Discussion. This is another of the most common genera of nautiloids in the Julfa Beds. The relative abundance of specimens and the fact that they are ornamented have led to a proliferation of species names, as is generally the case. Abich (1878) described three species that can readily be assigned to this genus, e. g., *Nautilus tubercularis* Abich, *N. pichleri* Hauer, and *N. incertus* Abich. Shimanskiy (in Ruzhentsev and Sarycheva, 1965: 41) recognized five species from the Dzhulfian beds of Soviet Dzhulfia, e. g., *Pleuromutilus incertus* (Abich), *P. verae* (Arthaber), *P. tubercularis* (Abich), *P. dzhulfensis* Shimanskiy, and *P. costalis* Shimanskiy. In addition, Shimanskiy listed three distinct intermediate

species of *Pleuronautilus*. The differences between these species are stated to be primarily in ornament pattern. However, it needs to be emphasized that all are based on relatively few and generally fragmentary specimens. The significance of the differences in ornament pattern is completely unknown. Kummel (1953), in a review of the genus *Pleuronautilus*, recorded 24 Permian species and 34 Triassic species. Most of these are likewise based on very few specimens. Because most species of pleuronautilids have been narrowly conceived, especially those from the Julfa Beds, we conclude it is inadvisable to assign specific names to our specimens.

Within our collection we have two distinct forms: the first, consisting of only one specimen, has a more compressed whorl section and the whorls increase in dimensions slowly; the second form includes 15 specimens and is characterized by a robust, depressed whorl section.

Our collections from the overlying Ali Bashi Formation contain two fragmentary specimens which resemble the specimens described here as *Pleuronautilus* sp. indet. 2, and they are possibly conspecific.

Pleuronautilus sp. indet. 1

Plate 1, figures 3, 4

Discussion. Among the 16 specimens of pleuronautilids in our collection one is distinctly different from all the others. This specimen is all phragmocone, 59 mm in diameter, 17 mm in width of adoral whorl, and 19.2 mm in height. The umbilicus is 25 mm in diameter. Both the venter and the lateral areas are slightly convex. The ventrolateral shoulders are sharply rounded, the umbilical shoulders more broadly so, and the umbilical wall slopes to the umbilical seam at an angle of about 45 degrees. The suture has a shallow ventral lobe and a broad lateral lobe occupying the whole flank. The lateral areas bear prominent radial ribs that extend from the umbilical shoulder to the ventrolateral shoulder where they terminate in a node.

Among the various species of this genus recognized by Shimanskiy from the Julfa Beds, our specimen most resembles *Pleuronautilus costalis* Shimanskiy. The resemblance is largely confined to the general shape and proportions of the whorl section. Our specimen lacks the additional rows of nodes on the ribs which are said to characterize *P. costalis*. However, as mentioned above, the significance of these differences in ornament is not known. Our specimen is also very similar to *P. verae* Arthaber (*in* Frech and Arthaber, 1900, pl. 18, fig.4). All other pleuronautilids from the Julfa Beds display a more rapid growth or inflation of the whorls, and, at the diameter of this specimen, already have robust, depressed whorl sections. In addition, the ornament pattern is highly variable.

Repository. KU 34384.

Pleuronautilus sp. indet. 2

Plate 4, figures 3, 4, 7, 8

Discussion. The remaining specimens of pleuronautilids in our collection are grouped under this heading. Most specimens are fragments, but two are fairly complete. The most characteristic feature is the depressed whorl section. The lateral areas bear ribs, and in this feature there is much variation. The large specimen of Plate 4, figures 3, 4 has ribs that originate on a low node on the ventrolateral shoulder, decrease in strength, and completely disappear across the mid-area of the flanks. In other specimens the ribs extend fully to the umbilical shoulder. There is likewise much variation in general prominence of the ribs, that is, in some specimens they are very weakly expressed and in others they are very noticeable.

The specimen of Plate 4, figures 3, 4 has the following dimensions: diameter 87 mm, height of adoral whorl section 31.5 mm, width of adoral whorl section 40 mm, diameter of umbilicus 28.5 mm. These proportions are typical of all the remaining fragments included here.

It is possible to match one or more of our fragments with *Pleuronautilus tubercularis*

(Abich), *P. incertus* (Abich), or *P. dzhul-fensis* Shimanskiy. However, as mentioned above, all these species are very incompletely known because they are based on few and generally poorly preserved specimens. Study of our suite of mainly fragmentary specimens leads us to conclude that this is nothing more than a single, somewhat variable species. It seems doubtful that there are possibly more than two species of *Pleuonautilus* in the Julfa Beds' fauna.

Repository. MCZ 9757 (Pl. 4, figs. 3, 4), MCZ 9758 (Pl. 4, figs. 7, 8), unfigured specimens MCZ 9759, KU 34389, 34414, 34415, 34419, 34427, 34428.

Genus *Tainionutilus* Mojsisovics, 1902

Type species, *Nautilus transitorius*
Waagen, 1879

Tainionutilus sp. indet.
Plate 3, figures 9, 10

Discussion. This identification is made on a single fragment of phragmocone consisting of only one-third revolution. The whorl section is depressed, subquadrate, measuring 41 mm in width and approximately 30 mm in height. The flanks are flattened and converge slightly toward the venter. The venter is broad and flattened. Both the ventrolateral and umbilical shoulders are sharply rounded. The venter bears a conspicuous, smooth, deep median furrow aligned on both sides by broad diagonal ribs that extend to the ventrolateral shoulder. The lateral areas do not appear to bear ribs, but this is uncertain because of poor preservation. The suture forms a deep ventral lobe on the venter and a broad rounded lobe on the lateral area.

Only five species have been referred to this genus, *Tainionutilus fugax* Mojsisovics, from the Bellerophon Limestone, the type species *T. transitorius* (Waagen), *T. wynnei* (Waagen), *T. multicostatus* (Reed), and *T. sp.* Reed from the Chhidru Formation of the Salt Range, West Pakistan. *Tainio-*

nautilus trachyceras Frech from the Mianwali Formation of the Salt Range also has been included in this genus. Our specimen is most similar to the type species, *T. transitorius*, but whether it is conspecific cannot be determined because of its fragmentary nature.

Shimanskiy (*in* Ruzhentsev and Sarycheva, 1965: 158, pl. 15, figs. 8a, b) identified one specimen from the Dzhulfian strata at Baisal as *Tainionutilus* sp. The specimen is small (34 mm diameter) and has conspicuous forward-projecting lateral ribs. The precise relationship of this specimen with ours is obscure because of poor preservation and the fragmentary nature of our specimen.

Repository. MCZ 9760, unfigured specimens KU 34391, 34413.

Family KONINCKIOCERATIDAE Hyatt,
in Zittel, 1900

Genus *Temnocheilus* McCoy, 1844

Type species, *Nautilus (Temnocheilus)*
coronatus McCoy, 1844

Temnocheilus sp. indet.
Plate 3, figures 1-4, 7, 8

Discussion. This very distinctive late Paleozoic genus is represented in our collection by one nearly complete phragmocone and six fragments. The best specimen (Pl. 3, figs. 3, 4) has a diameter of 61 mm, an adoral whorl width of 27 mm (measured on the nodes), and a whorl height of 15.5 mm. The umbilicus has a diameter of 30.5 mm. The whorl cross section is subtrapezoidal with a broad, only slightly convex venter, rounded ventrolateral shoulders, and convex lateral areas that converge toward the dorsum. The ventrolateral area bears prominent nodes spaced about the width of one camera apart. The suture has a broad shallow ventral lobe and a similar lobe on the lateral areas. A smaller fragment with a whorl width of 17 mm is illustrated on Plate 3, figures 7, 8. Three of the remaining fragmentary specimens are portions

of larger individuals. One specimen is a fragment of body chamber and measures 39 mm in width and 27.5 mm in height. Another fragment is a phragmocone consisting of four camerae that measures 43 mm in width and 21.5 mm in height. The larger fragments have the same whorl shape, ornament pattern, and suture as the more complete specimen of Plate 3, figures 3, 4.

Temnocheilus is fairly common in the Pennsylvanian and Permian. Kummel (1953: 18), in a general review of the genus, listed 23 described species from the U.S.A. and Eurasia. Within the family Koninckioceratidae *Temnocheilus* is a long-ranging genus that appears to have given rise to only one other form—*Foordiceras*. This is in sharp contrast to *Metacoceras*, which gave rise to a number of late Paleozoic genera (Kummel, 1953). What is of interest is that the two genera represent parallel evolutionary lines.

Shimanskiy (*in* Ruzhentsev and Sarycheva, 1965: 41) lists *Pseudotemnocheilus* from the *Araxoceras* and *Vedioceras* beds in Soviet Dzhulfa; however, he neither discussed nor illustrated these specimens. Kummel (*in* Teichert *et al.*, 1964) placed *Pseudotemnocheilus* in the synonymy of *Temnocheilus*. It would thus appear that this Soviet region includes in its nautiloid fauna a temnocheilid possibly similar to that of Kuh-e-Ali Bashi.

Repository. MCZ 9761 (Pl. 3, figs. 1, 2), MCZ 9762 (Pl. 3, figs. 3, 4), KU 34394 (Pl. 3, figs. 7, 8), unfigured specimens MCZ 9763.

Superfamily TRIGONOCERATACEAE
Hyatt, 1884

Family GRYPOCERATIDAE Hyatt,
in Zittel, 1900

Genus *Domatoceras* Hyatt, 1891

Type species, *Domatoceras umbilicatum*
Hyatt, 1891

Discussion. The predominant coiled nautiloids in our collections from the Julfa Beds

at Kuh-e-Ali Bashi are species of the genus *Domatoceras*. We have 35 specimens of which only a few are essentially complete. The same predominance prevails in correlative strata of Soviet Dzhulfa where Shimanskiy (*in* Ruzhentsev and Sarycheva, 1965: 41) reported 36 specimens. In addition to being represented by large numbers of specimens, there is also a great diversity in form. The differences in form are expressed primarily in the shape of the whorl section. Shimanskiy recognized from the *Araxoceras* beds the following species: *D. convergens* (Abich), *D. atypicum* Shimanskiy, *D. humicum* (Diener), *D. gracile* Shimanskiy, and *D. parallelum* (Abich). In the overlying *Vedioceras* beds Shimanskiy records *D. cf. gracile* and *D. sp. 1*, and in the equivalents of the Ali Bashi Formation, *D. sp. 2*.

Nautilus convergens Abich we believe to be a species of *Stenopoceras* rather than *Domatoceras*. *Domatoceras atypicum* Shimanskiy is an inflated form with a narrow concave venter and convergent convex flanks; our collections include two specimens of this species. We believe that *D. gracile* Shimanskiy is a synonym of *D. parallelum* (Abich); our collections contain eight specimens of this species. The most abundant species, represented by 23 specimens, is *D. humicum* (Diener), which has a subrectangular whorl section. Finally, our collections contain a fragmentary specimen consisting of one camera and a portion of body chamber, making up one-quarter of a volution of conch, and this seems to represent a very unique new genus of domatoceratid. The primary feature is a fastigate venter with a smooth sharp midline and the remaining ventral area convexly curving to merge with smooth flanks. To the best of our knowledge no other domatoceratid has such a whorl section. The presence of this form emphasizes the statement regarding the diversity of the domatoceratids in the Julfa Beds. Because our specimen is so fragmentary we refrain from introducing a new generic name, but that it

represents a new genus we have no question.

***Domatoceras hunicum* (Diener)**

Plate 1, figures 7, 8; Plate 2, figures 3, 4

Nautilus (*Domatoceras*?) *hunicum* Diener, 1903: 5, pl. 1, figs. 1a-c.

Grypoceras (*Domatoceras*) *hunicum*, - Kummel, 1953: 55.

Domatoceras hunicum, - Shimanskiy, in Ruzhentsev and Sarycheva, 1965: 41, pl. 15, fig. 12.

Discussion. This species is represented in our collections by 24 fragmentary specimens, most of which are body chambers. The species is characterized by an evolute, smooth conch with a subquadrate whorl section. The illustrated body chamber (Pl. 2, figs. 3, 4) has a whorl height of 27 mm and a width of 23 mm. The venter is flattened and the flanks are only slightly convex, converging gently toward the venter. The ventrolateral and umbilical shoulders are rounded. The siphuncle is central. The suture has a ventral lobe that occupies most of the venter and a lateral lobe that occupies nearly all of the flanks.

This species differs from the associated species in the fauna primarily in the shape of the whorl section. *Domatoceras parallelum* has a much more compressed whorl section and *D. atypicum* a more inflated whorl section with a relatively narrow venter.

Repository. MCZ 9764 (Pl. 2, figs. 3, 4), MCZ 9765 (Pl. 1, figs. 7, 8), unfigured specimens MCZ 9766, KU 34393, 34395, 34429, 34430.

***Domatoceras parallelum* (Abich)**

Plate 2, figures 1, 2, 9, 10

Nautilus parallelus Abich, 1878: 17, pl. 3, fig. 2. *Grypoceras* (*Domatoceras*) *parallelus*, - Kummel, 1953: 55.

Domatoceras parallelus, - Shimanskiy, in Ruzhentsev and Sarycheva, 1965: 41, pl. 15, fig. 10.

Domatoceras gracile Shimanskiy, in Ruzhentsev and Sarycheva, 1965: 160, pl. 16, fig. 1.

Discussion. This is the compressed form among species of *Domatoceras* in the

Dzhulfian fauna. The specimen of *Domatoceras gracile* illustrated by Shimanskiy (in Ruzhentsev and Sarycheva, 1965, pl. 16, fig. 1) is identical to our specimen illustrated on Plate 2, figures 9, 10. We believe these specimens to be juvenile forms; a mature phragmocone is that illustrated on Plate 2, figures 1, 2. In the more mature whorls the flanks are more parallel than in the immature whorls. Another difference is that the ventrolateral and umbilical shoulders of immature whorls are sharply rounded, though much less so than those of mature whorls. In conjunction with this change the venter on the inner whorls is flat but becomes slightly convex on the outer whorls. Our collections contain nine specimens of this compressed form, but we conclude that *D. gracile* is a synonym of *D. parallelum* (Abich).

Repository. MCZ 9767 (Pl. 2, figs. 9, 10), KU 34387 (Pl. 2, figs. 1, 2), unfigured specimens MCZ 9768.

***Domatoceras* sp. indet.**

Plate 2, figures 7, 8

Discussion. This species is represented by two fragments of phragmocone. The illustrated specimen (Pl. 2, figs. 7, 8) has a whorl height of approximately 28.5 mm and a width of 34.5 mm. The venter is slightly concave and has a width of 15 mm. The ventrolateral shoulders are rounded and the flanks broadly convex, diverging markedly toward the dorsum. The width of the whorl at the umbilical shoulder is nearly twice the width of the venter. The umbilical shoulders are sharply rounded. The suture has a ventral lobe occupying the venter and a lateral lobe occupying most of the flank.

These specimens are considerably different from any domatoceratid described or illustrated by Shimanskiy from Soviet Dzhulfia. It most resembles *Domatoceras atypicum* Shimanskiy. However, in that species the whorls are said to be higher than wide and the sutures to be straight

across the venter. The venter was described as narrow but is convex rather than concave. The shape of the whorl section of our specimens is unique among domatoceratids described to date. Unfortunately, the specimens are too incomplete for complete analysis.

Repository. MCZ 9769 (Pl. 2, figs. 7, 8), unfigured specimen MCZ 9770.

Domatoceratid n. gen., n. sp.

Plate 2, figures 5, 6

Discussion. One specimen in our collection is unique and clearly belongs to an undescribed new genus of domatoceratids. However, it consists of only one camera and a small portion of phragmocone. It is clearly too incomplete to be made the type of a new genus. The unique feature of the specimen is the acute venter with arching ventral shoulders blending smoothly with the lateral flanks. The suture begins with a pointed saddle on the acute venter, followed by a shallow concave lobe occupying all of the ventral shoulder, then an acute saddle followed by a broad concave lobe occupying the whole flank.

The acute venter and the suture clearly indicate that this specimen represents a unique, as yet undescribed new genus related to *Domatoceras*.

Repository. MCZ 9773 (Pl. 2, figs. 5, 6).

Genus *Pseudotitanoceras* Shimanskiy, in Ruzhentsev and Sarycheva, 1965

Type species, *Nautilus armeniacus* Abich, 1878

Discussion. When he established the genus *Pseudotitanoceras*, Shimanskiy (in Ruzhentsev and Sarycheva, 1965: 162) gave the following diagnosis (translated from Russian):

Shell large, evolute, discoidal, whorl section trapezoidal; height of whorls almost equal to width. Ventral side concave, lateral sides flat, diverging considerably towards the umbilical

shoulder. Ventral shoulder protrudes and is carinate, umbilical shoulder almost rectangular. Sculpture consists of oval tubercles stretched out along the ventral shoulder and of sparse oval tubercles on the umbilical shoulder. Sutures broad, with deep lateral and ventral lobes and a smaller and narrower dorsal one. A very small lobe occurs on the umbonal wall.

Shimanskiy further stated that (translated):

On the basis of the general shape of the shell, the concavity of the ventral side and the presence of oval tubercles along the ventral shoulder the new genus resembles *Titanoceras* Hyatt. The shape of the cross section is a distinguishing feature (being trapezoidal in our genus and having convex lateral sides in *Titanoceras*), and also the occurrence of pre-umbonal tubercles in *Pseudotitanoceras*.

In spite of this resemblance Shimanskiy concluded that the two genera were unrelated homeomorphs and that *Pseudotitanoceras* might belong to the family Mosquoceratidae.

***Pseudotitanoceras armeniacum* (Abich)**

Plate 1, figures 5, 6

Nautilus armeniacus Abich, 1878: 24, pl. 2, fig. 5.

Pseudotitanoceras armeniacum, - Shimanskiy, in Ruzhentsev and Sarycheva, 1965: 162, pl. 16, figs. 5, 6.

Discussion. Our collections include one specimen that can readily be assigned to this species. It is a large fragment of phragmocone of one-third volution. Only the venter and one lateral side are preserved. The most adoral part of the specimen most probably preserves a portion of the living chamber. Our specimen has a length of 120 mm; we estimate the total diameter is in excess of 200 mm. The ventral area is wide and markedly concave. The ventrolateral shoulders are acutely rounded and aligned by elongate, low nodes. The lateral sides

converge strongly toward the ventrolateral shoulders and are flattened except near the ventrolateral shoulder where they become slightly concave. The camerae are 12 mm high measured along the venter except the most adoral two camerae, which are 9 mm and 10 mm high. The suture has a deep V-shaped ventral lobe, a narrowly rounded saddle centered on the ventrolateral shoulder, and a broad, deep, rounded lateral lobe occupying the whole lateral area.

Our specimen is approximately twice the size of the largest recorded by Shimanskiy from Soviet Dzhulfa, but there is no reason to doubt that they are conspecific. This is the only species assigned as yet to *Pseudotitanoceras* and is known only from the Dzhulfian strata in the vicinity of the Aras River. Even here, however, it is rare, as Shimanskiy had only four specimens and we managed to collect only one.

Repository. KU 34392 (Pl. 1, figs. 5, 6).

Genus *Stenopoceras* Hyatt, 1893

Type species, *Phacoceras dumblei* Hyatt, 1891

Stenopoceras sp. indet.

Plate 1, figures 9, 10

Discussion. This record is based on a single fragmentary phragmocone of one-third revolution of only moderate preservation. The whorl cross section and suture are the key features in this identification. The whorls are compressed, lateral areas convex and converging to a narrowly rounded venter. The suture has a narrow, acute ventral saddle and a broad deep lateral lobe. These are the diagnostic features of the genus *Stenopoceras*.

Kummel (1953) reviewed the taxonomic and evolutionary data on *Stenopoceras* and listed eight species of the genus. Most of the species are known from Upper Carboniferous and Permian formations of the United States. One species, *S. rouillieri* (de Koninck) occurs in the Upper Carboniferous of central Russia. Our specimen is

too incomplete for meaningful comparison with the known species of the genus. Again it should be pointed out that all species are known from very few, often fragmentary specimens.

Stenopoceras is a compressed involute evolutionary offshoot of *Domatoceras*. In the Triassic, *Grypoceras* is the direct lineal descendant of *Domatoceras* and itself gave off a compressed involute line, *Gryponautilus*.

Repository. KU 34434 (Pl. 1, figs. 9, 10).

Genus *Titanoceras* Hyatt, 1884

Type species, *Nautilus ponderosus* Meek, 1872

Titanoceras sp. indet.

Plate 1, figures 1, 2

Discussion. Our collections contain one large specimen that represents an indeterminate species of this genus. The specimen is all phragmocone, consisting of one-third revolution. The specimen had a diameter of at least 140 mm. The adoral camerae have a height of 59 mm and a width of approximately 68 mm. The venter is broadly convex with rounded ventrolateral shoulders, broad flattened lateral areas, and rounded umbilical shoulder. The specimen is slightly crushed, but the whorl cross section appears to have been subquadratic with the whorl sides converging slightly toward the dorsum. The ventrolateral shoulders bear distant, large, low nodes spaced about 15 mm apart. The suture is nearly straight across the venter, but the lateral area is occupied by a broad lateral lobe. The camerae along the ventrolateral shoulder in the adoral portion of the phragmocone are 15 mm in width; in the two adoral camerae it is 4 mm.

Titanoceras is not a particularly common late Paleozoic nautiloid. Previously it has been reported only from Upper Carboniferous and Lower Permian formations of Nebraska and western Australia. There is no reason to doubt the generic assignment of our specimen, but specific comparison

with previously described species is of limited value because of its incompleteness.
Repository. MCZ 9771 (Pl. 1, figs. 1, 2).

Superfamily CLYDONAUTILACEAE Hyatt, in Zittel, 1900

Family LIROCERATIDAE Miller and Youngquist, 1949

Genus *Liroceras* Teichert, 1940

Type species, *Coloceras liratum* Girty, 1911

Liroceras sp. indet.

Plate 3, figures 11, 12

Discussion. This is one of the more common nautiloid genera in the Julfa Beds at Kuh-e-Ali Bashi. Our collections contain 16 specimens, most of which are fragmentary and slightly crushed. The largest specimen, consisting of a phragmocone, had a diameter of at least 100 mm.

Liroceras is one of the simplest of late Paleozoic nautiloids. It is characterized by a smooth, globular, involute conch with a depressed whorl section and an essentially straight suture. Even with well-preserved material specific identification is most difficult. Our material is not well enough preserved for this.

In view of the relative abundance of *Liroceras* in our collections, it is of interest that the genus is not listed by Shimanskiy (in Ruzhentsev and Sarycheva, 1965: 41) as a member of the nautiloid fauna in Soviet Dzhulfa. At the same time the specimens Abich (1878) described and illustrated as *Nautilus concavus* and *Nautilus propinquus* Abich appear to be conspecific with our forms. Our collections from the overlying Ali Bashi Formation contain two specimens of *Liroceras* for which there is no reason to believe that they are not conspecific with those recorded here from the Julfa Beds.

Repository. KU 34386 (Pl. 3, figs. 11, 12); unfigured specimens MCZ 9772 (10 specimens), KU 34418, 34385, 34420, 34424, 34426.

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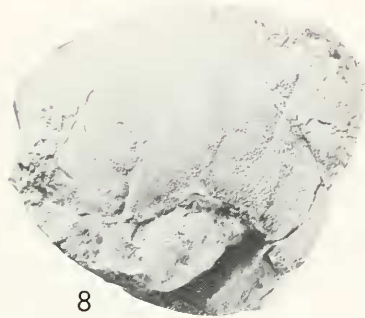
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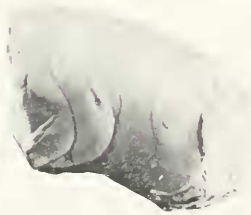
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